

II. DESCRIPTION OF A COLLECTION OF FOSSIL FISHES FROM THE BITUMINOUS SHALES AT RIACHO DOCE, STATE OF ALAGÓAS, BRAZIL.

BY DAVID STARR JORDAN.

The collection of fossil fishes described below was made under the direction of Dr. John Casper Branner in 1907 for the Carnegie Museum of Pittsburgh. The types described in this paper belong to that museum. Duplicates of the species are in the paleontological collections of the Department of Geology at Stanford University, California. The accompanying drawings are by Mr. Sekko Shimada.

Family CLUPEIDÆ.

Genus DIPLOMYSTUS Cope.

Diplomystus COPE, Bull. U. S. Geol. Surv. Terr., III, 1877, 808 (*dentatus*) (not *Diplomystus* Bleeker, a genus of catfishes).

Copeichthys DOLLO, Results Voyage Belgica, 1904, 159 (*dentatus*) (substitute for *Diplomystus*, considered as preoccupied).

A large, deep-bodied compressed herring from the Green River Eocene shales in Wyoming has been made the type of the genus *Diplomystus*. The characteristic features of the genus are the very strong ventral plates, and the presence of similar smaller plates on the dorsal line before the dorsal fin. At the same time another herring, obviously related, but differing in the slender form, short anal, and fewer vertebræ, besides other characters, was associated with this species. This species, *Clupea humilis* Leidy = *Clupea pusilla* Cope, both names preoccupied, became later, under the name of *Knightia eocæna*, the type of the genus *Knightia*. More or less intermediate between *Diplomystus* and *Knightia* are several species from the fossil beds of Europe and Asia.

Among Dr. Branner's Brazilian collections from Riacho Doce, are two new species allied to *Diplomystus*. Another, related to these, called *Diplomystus longicostatus*, has been already known from the Cretaceous of Brazil. These Brazilian species have the general traits of *Diplomystus dentatus*, with the short anal and fewer vertebræ of *Knightia*, while at the same time their squamation seems to be different from both. For this group I suggest the name of *Ellipes*. We may thus recognize among

American forms three types of double-armored herrings, representing two, or perhaps three, distinct genera. These groups may be thus compared:

DIPLOMYSTUS¹ (type *Diplomystus dentatus* Cope). (Plates V and VI.)

Vertebrae forty-two in typical species; the caudal vertebrae about twenty-three in number; anal fin long, with twenty-five to forty rays; ventral fins small, inserted before dorsal; ventral region very prominent, compressed; cleft of mouth very oblique, the chin prominent; teeth present, moderate; dorsal scutes pectinate; scales small, about sixty in number.

ELLIPES (type *Diplomystus branneri* Jordan).

Vertebrae about thirty-two, the caudal vertebrae twelve to seventeen; anal fin short, of about eight to twelve rays; ventral fins very small, much smaller than pectorals, inserted below or before dorsal; ventral region prominent, compressed; cleft of mouth oblique, maxillary narrow; no teeth so far as known; dorsal scutes entire; ventral scutes not serrate; scales apparently large, very thin, and deciduous.

KNIGHTIA² (type *Knightia cocæna* Jordan). (Plate VII.)

Vertebrae about thirty-six, the caudal vertebrae twenty-three; anal fin short, of about fourteen rays; ventral fins well-developed, as large as pectorals, inserted opposite front of dorsal; ventral region not at all prominent, body more or less elongate; mouth little oblique; maxillary narrow; no teeth so far as known; dorsal scutes entire; ventral scutes long; scales large, smooth, about thirty-five.

¹In the fine specimen of *Diplomystus dentatus*, figured in Plate V by the courtesy of Dr. John P. Merriam of the University of California, the opercle is covered with large irregular scales. As no scales occur on the head in any other known herring, these are probably loose scales out of place in the specimen?

[EDITOR'S NOTE. In December, 1898, I received from Mr. Henry L. Ward of Rochester, N. Y., as a Christmas present, a slab from the Green River Shales at Fossil, Wyoming, containing, as he humorously wrote me, "a painting by the oldest of masters." This slab represents a specimen of *Diplomystus dentatus* Cope, in even finer preservation than the one figured by Dr. Jordan, and represented in Plate V. I have had the slab photographed and take the liberty of annexing a reproduction of the photograph as Plate VI to this article, and trust that Dr. Jordan will forgive me for the act.—W. J. HOLLAND.]

²*Histiurus* COSTA, Atti Accad. Pontan., V, 1850, 288 (*elatus*); not *Histiurus* Agassiz, an emendation of *Istiurus*.

Knightia JORDAN, Univ. Cal. Publ., V, No. 7, 136 1907, (type *Knightia cocæna* Jordan = *Clupea humilis* Leidy, 1856, not of Meyer, = *Clupea pusilla* Cope, 1877, not of Mitchell).

HYPERLOPHUS Ogilby. (Rec. Austr. Mus., II, 1892, 26. Type *Hyperlophus spratellides*, the "Sandy Sprat" of streams of New South Wales.)

Maxillary broad; no teeth; mouth very small; mandible projecting; branchiostegals four; dorsal inserted behind middle of body; ventrals inserted before dorsal; dorsal scutes small; ventral scutes moderate; anal of about nineteen rays; scales pectinate. Dr. Woodward regards *Hyperlophus* as a synonym of *Diplomystus*, which is quite unlikely. One may be too hasty in regarding living forms as identical with extinct genera, as well as too hasty in separating them.

POTAMALOSA Ogilby. (Proc. Linnean Soc. N. S. W., XXI, 1897, 504.

Type *Clupea novæ-hollandiæ* C. & V. of streams of Australia.)

Maxillary narrow; teeth present in jaws and palate; branchiostegals eight; dorsal inserted before middle of body; anal small; ventrals under front of dorsal scales large, smooth; dorsal scutes small; ventral scutes moderate.

Allied to *Potamalosa* are certain American species, typified by "*Potamalosa*" *notacanthoides* (Steindachner) of Chile. This species has the form of an alewife; maxillary rather broad; no teeth; scales rather large and firm, cuneate; dorsal and ventral scutes small; ventrals moderate, under front of dorsal; anal short; fourteen rays; caudal scaly. This species stands between *Ellipes* and *Potamalosa*.

In any event, I think that we are justified in recognizing *Ellipes*, *Potamalosa*, *Hyperlophus*, and *Knightia* as distinct subgenera, even if we should wish to place all double-armored herrings in the single genus, *Diplomystus*.

1. *Ellipes branneri* sp. nov. (Plate VIII, fig. 3.)

Type, a small, much compressed herring pressed flat in black shale, from Riacho Doce, Alagôas, Brazil, J. C. Branner, collector. Total length 2 to $3\frac{1}{3}$ inches.

Head 3 in length to base of caudal; depth 2; length of longest rib a shade more than length of head. Distance from snout to nape equal to distance from nape to dorsal fin. Length of caudal portion of abdominal column equal to length of head and two-thirds greatest depth. Body short and deep, the back not elevated; the belly very convex and sharply keeled, with about twenty sharp plates; plates in front of dorsal mostly lost; those present small and entire; caudal peduncle deeper in front than long. Head rather deeper than long. Maxillary more or less crushed

in all examples, about $2\frac{1}{2}$ in length of head reaching to below the front of eye, about 2 in head in the larger and extending below posterior part of eye. Lower jaw oblique, about as long as upper, slightly projecting in the larger example. No trace of teeth. Eye small, a little longer than snout, about $3\frac{1}{2}$ in head; preopercle widened below; opercle deep, about as long as eye; sharply striated in the larger examples, smooth in the smaller. In the larger specimens the opercle is longer than the eye.

Dorsal fin low, median, its rays uncertain, about twelve; caudal deeply and evenly forked, the lobes a little longer than head; anal short, its rays lost in the type example, but perfectly preserved in No. 51, the fin low, even, with twelve rays, usually one to each interspinal bone, but sometimes two; pectorals short, placed low, the bases of about eight rays showing; ventrals lost in most specimens, in others very small and inserted behind front of dorsal, under the thirteenth rib. Only the base is preserved, but the fin must have been very short. In most of the specimens, the interspinal bones behind the anal end in little knobs, to which the rays are jointed.

Vertebrae about $15 + 17 = 32$, or $16 + 17 = 33$. Ribs about 20, 24 in larger examples; scales thin, large, nearly all gone, traces of a few on lower part of belly. Some of these seem quadrate in form and plate-like, but of thin texture.

Of this species the type is a small specimen, Collector's No. 1, very perfectly preserved, except for the fin-rays (Plate VIII, fig. 3). It is 2 inches long, with the caudal, and it is represented by an equally perfect duplicate, Collector's No. 2.

Almost equally perfect is another specimen, $3\frac{1}{5}$ inches long, Collector's No. 29, also figured (Plate VIII, fig. 4). This has an equally perfect duplicate, Number 27. Other relatively perfect examples are Numbers 65 and 66 (duplicates), both showing the anterior half of body. Another, 28, shows the relatively large mouth and rather broad, striated opercle, Other examples broken but in parts perfect, are the following: 30, 31, 32, 33, 34, 38, 40, 41, 42, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 65, 66, 92, 98, 125, 130.

In 46, the ventral scutes are especially well preserved. In none is there any trace of the dorsal scutes. In No. 51, the upper half of the body is lost, the belly with the anal fin very well preserved. This anal fin is restored in fig. 4. Number 125, and its duplicate Number 130, are very small, about an inch long, but very perfectly preserved. We present a figure of Number 125 (Plate IX, fig. 6). Other fragments very badly broken are Numbers 144, 175, 177, 194, 201, 204, 222, 221, 238, 257.

This species apparently belongs to the same group as *Diplomystus longicostatus* Cope, but the latter is readily distinguished by the much elevated back, on which the dorsal fin is perched, and by the much longer ribs, as well as by the great enlargement of the posterior ventral plate.

In both species the ventral fins are very small and median, but in *Ellipes longicostatus* they are inserted well before the dorsal under the eleventh rib, the dorsal being thrown backward by the oblique setting of the body. The insertion of the ventrals behind the front of the dorsal separates *Ellipes branneri* and *E. riacensis* from *E. longicostatus*, as well as from *Diplomystus dentatus* of the North American Eocene.

I have submitted specimens of *Ellipes branneri* to Prof. T. D. A. Cockerell, of the University of Colorado. Professor Cockerell says:

"I have examined the scales of *Ellipes* with very great interest. In no one case can I see the outline of a complete scale, but the transverse circuli are very well developed, and the scales are evidently large. I cannot distinctly determine that they differ in any respect from those of the common herring, except perhaps that the sculpture is not quite so uniform. I cannot see the transverse radii, but these might not be visible in preserved material, and possibly the radii did not exist in these ancient herrings."

We refer to *Ellipes branneri*, with some doubt, two other specimens well preserved, Number 3 described below, with another specimen of the same size, well preserved, but broken into two (Number 24 and Number 25). These agree with the type of *Ellipes branneri* in all technical characters, but the body is more elongate, especially posteriorly, and the ventral region less gibbous and more angulated. The belly is deeper, and the mouth larger than in *Ellipes riacensis*.

Number 3 is a little fish $2\frac{3}{4}$ inches long, very perfectly preserved in black shale, collected at Riacho Doce, state of Alagôas, Brazil. (Plate VIII, fig. 5.)

Head $3\frac{1}{2}$ in length to base of caudal; depth $2\frac{1}{5}$; length of longest rib considerably more than length of head. Distance from snout to nape about equal to distance from nape to dorsal fin. Length of caudal part of vertebral column equal to greatest depth, and half more than head. Body deep mesially, the caudal region produced. Belly very convex and sharply keeled, the plates strong and sharp, about 17 in number; trace of four or five scutes before dorsal. These are subacute, smooth, and entire. Caudal peduncle longer than deep in front; head deeper than long. Maxillary about 2 in its length, reaching to below middle of eye; lower

jaw thin, oblique, projecting beyond upper. No trace of teeth. Eye small, rather shorter than snout; $3\frac{1}{4}$ in head, longer than opercle; opercle short and deep, more or less striated, and shining black (the bones more or less crushed and obliterated).

Dorsal fin lost; caudal fin equally and sharply forked, half longer than head; anal short, its rays lost, about 14 in number. Pectorals low, not very short; about seven rays evident; ventrals obliterated, probably behind front of dorsal. Vertebræ $14 + 19 = 33$. Ribs about 18. Traces of shining scales between the ribs.

2. *Ellipes riacensis* Jordan, sp. nov. (Plate X.)

Type a fish pressed flat in black shale, and well preserved, Collector's Number 4. Length $4\frac{7}{8}$ inches. From Riacho Doce, Alagôas, Brazil, Branner Collection.

Back little convex, the belly more curved but not prominent. Head $2\frac{1}{3}$ in length to base of caudal; depth $2\frac{2}{5}$; length of longest rib a shade less than length of head; distance from snout to nape a little less than from nape to dorsal; length of caudal part of vertebral column equal to greatest depth and a shade more than length of head. Body moderately deep mesially, about as in species of *Sardinella*, the back scarcely elevated. Belly sharply keeled, the plates strong, about 23 in number, the hindmost not enlarged. Scutes before dorsal mostly lost, apparently entire and with flexible edges. Caudal peduncle longer than deep. Head rather longer than deep. Maxillary $2\frac{1}{2}$ in head, not reaching front of eye; mouth small, the lower jaw in the type apparently shorter than upper, its position apparently due to distortion; as in other specimens, the chin projects. Eye small, shorter than snout, 4 in head, not longer than opercle. Opercle moderate, its surface polished and striated; subopercle evident, nearly as large as opercle. Dorsal fin preserved, apparently of about 15 rays. Caudal fin a shade longer than head, equally and sharply forked. Anal fin short, probably of about 14 rays, most of them obliterated. Pectorals present, crushed. Ventrals small, inserted behind front of dorsal. Traces of small smooth shining scales between the ribs and on various parts of the body. Vertebræ $13 + 18 = 31$. Ribs about 19. Interspinal bones behind anal mostly ending in little knobs to which the rays are joined.

This fish is formed much like an alewife, but with the ventral plates much stronger. From *Ellipes branneri* it differs in the longer head, smaller mouth, shorter lower jaw, shorter ribs, more elongate body, and broader striate opercle.

The type is a fine example, Collector's Number 4, of which Collector's Number 5 is the duplicate, equally well preserved. In numerous others, Collector's Numbers 5 to 23, also 26, 35, 36, 37, 39, 43, 44, 49, 70, 80, 81, and 104, the whole or a part of the body is preserved. Other fragments are Numbers 152 and 171. All are of about the same size, and in all the mouth seems to be small, though the shortness of the lower jaw in the type may be in part due to "telescoping." Only one specimen, the type, shows the ventral fins.

Collector's Number 6 is fairly preserved, and shows the mouth closed, the jaws subequal, the mouth apparently small. Number 7, with two specimens, shows the mouth small, the lower jaw projecting. The sides show a few shining scales, thin and small. Number 9 and Number 20 show a projecting chin, the mouth being small. Number 10 shows the mouth much as in type. In all, the posterior ventral scutes are distinct. They show none of the enlargements peculiar to *Ellipes longicostatus* (Cope). In Number 21 the posterior scutes are broadened, but not much enlarged.

***Ellipes longicostatus* Cope.**

Diplomystus longicostatus COPE, Proc. Amer. Phil. Soc. XXIII, 1886, 3 (Upper Cretaceous, Bahia, Brazil).—WOODWARD, Ann. Mag. Nat. Hist., (6), II, 1888, 134 (Itacaranha).—WOODWARD, Ann. Mag. Nat. Hist. (6), XV, 1895, 2, pl. 1, fig. 1 (Upper Cretaceous beach between Itacaranha and Plataforma, Brazil).—WOODWARD, Cat. Fossil Fishes, IV, 1901, 143 (same specimens).

We found no specimens of this species, but present for comparison with the others a copy of Woodward's figure (1895). (Plate XI.)

The greatest elevation of the dorsal region and the great length of the ribs, as well as the position of the ventrals, will separate this from the other Brazilian species of *Ellipes*.

DASTILBE Jordan, genus nov. (type, *Dastilbe crandalli* Jordan).

? *Halecopsis* AGASSIZ, Poisson Fossiles, V, pt. 2, 1844, 139 (*lævis*), name only.

? *Halecopsis* WOODWARD, Cat. Fossil Fishes, IV, 1901, 133; type, *Osmeroides insignis* Delvoux and Ortleb.

In this collection are very many well-preserved specimens of a species of herring-like fish not closely related to the genus *Diplomystus*, and apparently forming a new genus which we call *Dastilbe*.

The following are the apparent characters of the genus: body moderately elongate, moderately compressed, the back but little less gibbous than the belly. No evidence of ventral scutes, the belly perhaps rounded. No trace of dorsal scutes. No trace of anal finlets. Head probably

moderately acute, the mouth not very large, oblique, the jaws subequal. Opercle very large, longer than eye, smooth and convex; subopercle distinct; preopercle well developed but not expanded; scales small, even, represented by depressions or pits; about 50 in lateral series. Dorsal fin median, short and high, of about 12 rays. Anal short and rather low, of about 12 rays; 2nd interhæmal strong. Ribs short. Ventrals well developed, about as large as pectorals, inserted under front of dorsal. Pectorals moderate. Vertebrae about $17+13=30$. Caudal deeply forked. The opercle, nearly round, very large, smooth or slightly striated, shining black as preserved, is a most conspicuous feature of the broken specimens of this species. We are not able to place this fish in any of the recognized genera. Assuming that it is a herring, which is most probable, its nearest relative would seem to be the genus *Halecopsis* of the Eocene of Europe. But *Halecopsis* has the preopercle greatly expanded, while the opercle is moderately developed. The reverse is true in *Dastilbe*, in which the large opercle shining black in the fossil state is a most conspicuous feature of the fragments in the rocks.

We name our species of this group *Dastilbe crandalli*. We are reasonably certain that it is distinct from a Brazilian fish described by Woodward as *Scombroclupea scutata*, as that species has forty vertebrae, a lower dorsal, and no traces of the very conspicuous opercle characteristic of *Dastilbe*. In any event, our fish cannot be a *Scombroclupea*. The generic traits of *Scombroclupea*, the finlets and scutes behind the anal, and the strong short plates along the ventral line are wanting in *Dastilbe crandalli*.

3. *Dastilbe crandalli* Jordan (sp. nov.)

?*Scombroclupea scutata* WOODWARD, Quart. Journ. Geol. Society, LXIV, No. 255, 1908, 360, pl. XLIII, fig. 3, 4. (Ilhéos, Brazil.)

The following account is drawn particularly from No. 91, $2\frac{3}{4}$ inches in length, collected by Dr. J. C. Branner, at Riacho Doce (Plate IX, fig. 9).

Body moderately elongate, compressed, the depth $3\frac{1}{5}$ in length to base of caudal. Head $3\frac{1}{5}$ in length. Head badly crushed in all specimens, especially anteriorly, the eye apparently about as long as the snout; snout moderately acute, but crushed; mouth not very large, oblique, its structure apparently as usual in herrings. Opercle unusually large, forming nearly two-fifths length of head; about as deep as long, convex, and nearly smooth. It is shining black as seen in the rocks, and is recognizable, however crushed the specimen may be. Subopercle rather large, evident

n some specimens, crushed under the opercle in others. Preopercle preserved in one or two examples only, normally formed, rather large, but not expanded, its angle about a right angle. Some shining bones or plates on top of head. Vertebrae $17 + 13 = 30$ (to 32), those of the caudal portion relatively few, the caudal region barely half as long as the abdominal region. Distance from snout to nape rather more than from nape to front of dorsal.

Dorsal rays not to be accurately counted, about 12 in number, perfect in one specimen, Number 71. very high, twice as high as long; anal rays apparently about 12. Ventrals well developed, about as large as pectorals, inserted below front of dorsal, and distinct in all specimens, the rays apparently 8. Pectoral short, placed low. Body marked with depressions, the imprint of small rounded scales, these about 50 in a linear series. Anterior interspinal bones of dorsal and anal better developed than usual in herrings. Caudal long, sharply forked, the lobes equal, $1\frac{1}{5}$ in head. No trace of ventral nor of dorsal scutes. No trace of finlets behind anal. Ribs short, rather straight, about 19 in number.

The type of this specimen mentioned is pressed flat in black shale, the head interiorly crushed, and not clearly shown. Its salient traits are its form, the development of its ventral fins, the absence of the scutes so well developed in Brazilian species of *Diplomystus*, the development of its interhæmals and the shortness of the ribs and the large size of the opercle.

Besides No. 91, here figured, we have 92. its duplicate, equally well preserved, $2\frac{3}{4}$ inches long. No. 112, also figured (Plate IX, fig. 12), is very small, scarcely more than an inch long, and Numbers 67, 68, 69, 71, 72, 73, 75, 76, 77, 74, 78, 82, 86, 87, 84, 88, 89, 90, 91, 93, 94, 95, 96, 97, 102, 103, 105, 107, 110, 111, 112, 113, 118, 119, 120, 121, 122, 123, 124, 126, 127, 128, 129, 131, 132, 133, 134, 195, 196, 197, 198, 199, 200, are of various sizes up to 3 inches, and in fair condition of preservation. In Number 71 the dorsal fin is well preserved, and is unusually high, twice as high as long, the longest ray nearly as long as head. In Number 195, a crushed head, the opercle and preopercle are conspicuous. This specimen we figure (Plate IX, fig. 11). In Number 200 (Plate IX, fig. 10) the head is lost, but the body is very well preserved and the scale imprints are very evident. We figure this specimen also. In many specimens the large opercle, crushed and dislocated, smooth and shining black, is conspicuous.

Broken fragments, mostly identifiable by the large opercles, or by the ventral fins, are the following Numbers: 135, 136, 137, 138, 139, 140, 143

146, 147, 149, 150, 151, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 172, 173, 174, 176, 178, 179, 180, 181, 182, 183, 184, 185, 187, 188, 189, 190, 191, 192, 193, 203, 205, 207, 209, 210, 208, 212, 213, 214, 215, 216, 217, 218, 220, 223, 224, 225, 227, 229, 230, 231, 232, 233, 234, 235, 237, 239, 241, 242, 243, 245, 246, 247, 248, 250, 254, 255, 256, 257, 258, 260, 261, 262, 265, and 266.

Of these, all numbers above 202 are very fragmentary and of little value. In none of these is there any trace of the small scutes at the ends of the interhæmal bones mentioned and figured by Dr. Woodward.

This species agrees in many respects with the two fragmentary specimens from Ilhéos, named *Scombroclupea scutata* by Dr. Woodward. But in none of our specimens, although fairly perfect, do we find any trace of the little scales or scutes at the tip of each interspinal bone behind the anal fin figured by Dr. Woodward and considered by him to be the bases of finlets nor do we find any trace of ventral scutes, and there could have been none of these in life. Moreover, *Scombroclupea scutata* has 40 vertebræ instead of about 30, as in *D. crandalli*.

It is evident that our species cannot belong to *Scombroclupea*, as in that genus finlets are present behind the anal fin, and the ventral ridge is armed with strong plates, as in *Diplomystus*. The genus *Halecopsis* seems nearer to our specimens, but the character of the enlarged preopercle, which defines *Halecopsis*, cannot be verified on any of them. In Woodward's scheme, they might be referable to *Clupea*, but none of the fossil fishes called *Clupea* are congeneric with the Common Herring, *Clupea harengus*. Among other points of difference, *Clupea* has over 50 vertebræ, and no Tertiary or Cretaceous fish with 30 vertebræ belongs in the same genus as the common living herring.

If the detached ventral ridge scale figured by Woodward really came from the specimen on which it lies, his species, *scutata*, may be really a *Scombroclupea*, in which case our species is unquestionably different.

This species is named for Mr. Roderic Crandall, of Stanford University, assistant to Dr. Branner on this expedition, and now geologist to the Geological Survey of Brazil.

Family CHIROCENRIDÆ.

4. *Chiromystus alagoensis* Jordan, (sp. nov.)

In the collection are several fragments of a large fish, about a foot long, apparently belonging to the genus *Chiromystus*, figured by Allport (without name) and later described by Cope and by Woodward from the Upper Cretaceous at Bahia.

Our species, from the Eocene, seems somewhat different from *Chiromystus mawsoni* Cope, and we give it the name of *Chiromystus alagoensis*.

The type, Number 100, with its duplicate, Number 106, represents the jaws and part of the skull, with other crushed structures, the broad and strong pectoral fins being attached. The first ray of the pectoral is very broad and flat, and there are five other rays well defined, with traces of two or three more. The membranes connecting the first three rays are represented and are distinctly striate. The mouth is very large, with a long, curved maxillary, extending to the articulation of the lower jaw and extending far beyond the point where the eye seems to have been located. In the front of the maxillary are moderate teeth. The jaws are subequal, the cleft of the mouth oblique, the lower jaw very heavy, with a prominent lateral ridge and a longitudinal depression below. There are a number of moderate, subequal teeth preserved.

Number 116 (Plate IX, fig. 15), with its duplicate, Number 117, represent the pelvis of a fish, with two ventral fins, each with about six broad, articulated rays, the first two or three very wide, and all much branched towards their tips. As these fins are about an inch long, they must have belonged to a large fish, certainly the same as number 100, and probably to the same species as number 114 also.

According to Woodward, the ventral fins in *Chiromystus mawsoni* are very small. If *C. alagoensis* is also a *Chiromystus*, the size of these fins will indicate a specific difference. The form of the jaws in this fish agrees very fairly with Allport's figure (Quart. Journ. Geol., XVI, 1860, Pl. XIV, fig. 4).

Collector's Number 114 (Plate XIII) and its duplicate, Number 115, represent the posterior part of a long vertebral column, containing 30 vertebræ and indicating that the total number must have been 50 or 60. The vertebræ are about as long as deep, double concave, each posteriorly, with three coarse ridges on each side between these two deep, longitudinally extended pits. The caudal fin is slender, the lower half preserved, apparently deeply forked, the anterior rays springing from the last five of the vertebræ. The caudal seems to have been deeply forked, and sharp at tips, the rays stout at base and jointed. There are traces of a long anal fin, with here and there a ray preserved, and in the surface of the specimen there are traces of what may have been small cycloid scales, but possibly only fragments of skin.

Number 202 is a part of the vertebral column of a smaller example of the same species, but in such bad condition as to show nothing. The

caudal fin of Number 114 suggests at first sight the figure of *Mawsonia minor*, as given by Woodward, Quart. Journ. Geol., LIV, 1908, 358, Plate XLIV, a Brazilian Cretaceous fish. But that species is a *Cælacanth*, with imperfect or cartilaginous vertebræ, and it can have no real affinity with this species, which is doubtless one of the Chirocentrid herrings.

AGE OF DEPOSITS AT RIACHO DOCE.

Judging from our knowledge of similar fishes among the existing species, it is probable that the shales of Riacho Doce were deposited in an estuary, and that their age is Lower Eocene, possibly but not probably Upper Cretaceous.

Most of the known species of *Diplomystus* are of later than Cretaceous date. It is also noteworthy that in the Cretaceous about Bahia and about Ceará, none of the species here noted from Riacho Doce were taken. On the other hand, the species found at Riacho Doce are all unlike any yet seen in the Cretaceous. All this would seem to show that the rocks examined in the state of Alagoas are Eocene, while those about Bahia are of the Upper Cretaceous.